Chilled Storage of Malaysian Fishballs and Hazards and CCP Analyses

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Abstract

Fishballs from six local factories were stored at 5°C for 1, 2, 3, 4, 7 and 10 days. There were no changes in texture at 3 days of storage but bacterial spoilage rendered the fishballs unacceptable by the fourth day. Most of the bacteria were non-halophilic. The main genera isolated were Aerococcus, Acinetobacter, Pseudomonas, Staphylococcus, Corynebacterium, Micrococcus, Streptococcus, and Enterobacteria. Hazards and critical control points have been identified at various stages of fishball processing.

Introduction

Fishballs are a popular food in much of the Asian region. Made by mixing fish mince with starch, salt, sugar, monosodium glutamate and spices into a ball-shaped dough, they are cooked to a gel which is consumed with rice, noodles or as a snack. They are usually sold in local wet markets, unchilled and with little or no packaging. Being a high moisture food (>80%) they are highly perishable with a short shelf life. Thus, data on their spoilage characteristics is necessary before monitoring and control systems can be implemented.

Materials and Methods

1. Raw Material

Freshly-produced fishballs were purchased from the six largest factories in Kuala Lumpur. The samples were packed in aseptic plastic bags and transported immediately to the laboratory. Upon arrival at the laboratory, the fishballs were transferred using aseptic forceps into sterile plastic bags (200g per bag), sealed in a laminar-flow chamber, and stored at 5°C. Samples were analysed at 0, 1, 2, 3, 4, 7 and 10 days of storage. Two samples from each factory were tested for each parameter on each day except for the folding test, when 5 samples were tested.

2. Physical tests

The Folding and Teeth-cutting Tests of Hasegawa (1987) were used. The Folding Test measures resilience and the Teeth-cutting Test measures springiness of the fishballs. Samples were boiled for 5 mins. and then cooled to room temperature (28°C) before testing.

a. Folding test

Five slices, each 5mm thick and 20mm in diameter, were cut from five fishballs. Each was then folded in half and if there was no tear or breakage, further folded into quarters. The grading was as follows : AA, no breakage in any of five samples when folded in quarters; A, slight tear in any one of five samples when folded in quarters; B, slight tear in any one of five samples when folded in half; C, breakage (but 2 pieces still connected) when folded in half; D, breaks completely into 2 pieces when folded in half.

b. Teeth-cutting test

This test gives a subjective assessment of the resistance experienced by a trained panel of 10 when the test piece is bitten between the upper and lower incisors. Two slices of 5mm in thickness and 20mm diameter were tested. Scores were attributed as follows : 10, extremely strong springiness; 9, very strong springiness; 8, strong springiness; 7, quite strong springiness; 6, acceptable springiness; 5, acceptable, slight springiness; 4, weak springiness; 3, quite weak springiness; 2, very weak springiness; 1 mushy texture, no springiness.

3. pH measurement

A 10g sample was homogenized in 90ml of distilled water and the pH measured using a combination electrode with a Ag/Ag C1 reference system (Model HI 1911B, Hanna Instruments SpA, Padova, Italy).

4. Microbial Analyses

a. Aerobic plate count

Whole fishballs were ground in a sterile Waring Blender flask, using two samples from each factory. The method as described by the American Public Health Association (1976) was used. Plates

containing 25-250 colonies were counted after incubation at 35°C for 48h, and 5°C for 144h.

b. Halophilic and non-halophilic bacteria

Samples from the plate count were inoculated onto nutrient agar containing 0%, 5%, 10% and 15% NaCl and incubated at 5°C, and 35°C, for 48 and 24h, respectively. Results were obtained by counting the number of colonies on the media.

c. Generic characterization

Colonies from the plate count and nutrient agar were isolated and identified using the Primary Characterization tests of Cowan (1975).

d. Hazard & CCP's identification

Visits were made to all the 6 factories and a detailed study of the processing methods used was carried out. Fig. 1 shows the hazards and CCP's identified in the processing line.

Results

1. Physical changes in fishballs during storage

No significant changes in the pH and the resilience measured by a Folding Test were detected after 10 days of storage at 5°C (Table 1). All samples were graded to AA. There were no changes in the Teeth-cutting score after 3 days. However, in terms of appearance and odour, the fishballs became unacceptable on the fourth day of storage. An unpleasant odour associated with spoilage was detected and the surface of the fishballs were covered with slime. The presence of a turbid and viscous exudate was also noticed.

2. Effect of storage on bacterial flora

The average number of mesophiles (measured at 35°C) after one day storage (Table 2) would be considered unsafe for human consumption if they were consumed without re-cooking. By day four the mesophile numbers reached an unacceptable level. The number of psychrotrophs (measured at 5°C) at day four also indicated spoilage of the product.

No halophilic psychrotrophs and few halophilic mesophiles were detected (Table 3) indicating that most of the spoilage organisms were of land origin. The non-halophilic psychrotrophs increased with time whilst the non-halophilic mesophiles remained virtually constant. Initially, there were twice as many mesophiles as psychrotrophs, but by day three they were approximately equal and thereafter the psychrotrophs predominated.

Table 1. Physical changes of fishballs during storage at 5°C*.

Day	pH	Teeth-cutting test	Appearance/Odour
0	7.23 ± 0.09	8.0 ± 0.7	Fresh, shiny and glossy, smooth. Fishy.
1	7.27 ± 0.12	8.0 ± 0.5	Fresh, shiny and glossy, smooth. Fishy.
2	7.25 ± 0.13	8.0 ± 0.4	Slight exudate, a bit milky, less glossy and shiny. Fishy, slightly pungent odour.
3	7.24 ± 0.08	8.0 ± 0.5	Slightly milky exudate, glossy and wet. Stronger fishy odour.
4	7.22 ± 0.11	- -	Slimy, milky and viscous exudate, glossy and wet. Slightly unpleasant odour.
7	7.18 ± 0.10)	-	Slimy. Yellow-milky exudate. Patches of yellow on fishballs. Unpleasant odour.
10	7.30	± 0.08	Slimy. Yellow-milky exudate. Very unpleasant odour.

* Average values of samples from 6 factories. Numbers in brackets are standard deviations of the mean.

3. Generic characterization tests

Results of the characterization tests are shown in Table 4. The eight dominant species isolated were classified under the terms of genus *Aerococcus, Acinetobacter, Pseudomonas, Staphylococcus, Corynebacterium, Micrococcus, Streptococcus* and *Enterobacteria.*

Table 2. Aerobic plate counts (organisms g^{-1} sample) of fishballs during storage at 5°C*.

Day	Aerobic Plate Count (APC/g) Sample	
	5°C	35°C
0	2.2×10^4 ± 1.0	2.6×10^5 ± 0.9
1	7.5×10^5 ± 2.1	5.4×10^6 ± 1.8
2	2.6×10^6 ± 1.7	6.6×10^6 ± 2.0
3	2.2×10^7 ± 1.5	3.6×10^7 ± 1.7
4	8.1×10^7 ± 2.7	1.0×10^8 ± 1.5
7	1.1×10^8 ± 2.3	2.0×10^8 ± 1.8
10	1.2×10^8 ± 1.5	2.2×10^8 ± 2.2

*Average values of samples from 6 factories. Numbers in brackets are standard deviations of the mean.

Table 3. Halophilic and non-halophilic bacteria during storage of fishballs at 5°C*.

Days of storage	Number of colonies			
	Halophilic		Non-Halophilic	
	Psychro (5°C)	Meso (35°C)	Psychro (5°C)	Meso (35°C)
0	-	1	8	14
1	-	-	9	19
2	-	-	11	21
3	-	1	19	18
4	-	-	21	17
7	-	1	23	16
10	-	-	22	15
Total (%)	0	3 (1.3%)	113 (47.9%)	120 (50.8%)

*Average values of samples from 6 factories.

Table 4. Generic characterisation of bacterial flora isolated from fishballs*

Genera	Shape	Gram Stain	Motility	Catalase Test	Oxidase Test	Oxidative or Fermentation
Aerococcus	C	+	-	W	-	F
Acinetoba cter	C	-	-	+	-	O
Pseudomonas	R	-	+	+	+	O
Staphylococcus	C	+	-	+	-	F
Coryne-bacterium	R	+	-	+	-	F
Micrococcus	C	+	-	+	-	O
Streptococcus	C	+	+	-	-	F
Enterobacteria	R	-	+	+	-	F

Note : C = Cocci; R = Rod; W = Weak Reaction
*Based on analyses of samples from 6 factories.

Discussion

Fishballs produced in Malaysia have a high initial bacterial contamination and although there were no changes in texture, bacterial spoilage rendered the fishballs unacceptable by the fourth day of storage. Most of the fishballs are produced by cottage-scale industries dependent upon manual labour and using a minimum of equipment. The short shelf life of fishballs may be due to a combination of some or all of the following points : raw materials that are not fresh and are heavily contaminated due to poor handling after catch; slow processing at ambient temperatures (30-35°C) and poor personal hygiene result in further deterioration of raw materials; use of dirty processing equipment; cooked products are left to cool in rattan baskets on the floor for long periods; packaging is done manually; packed products are often distributed in non-refrigerated vans and lorries; fishballs are sold at ambient temperatures in the market.

Malaysian law does not permit the use of preservatives in fishballs. Despite this, many processors have been known to use common preservatives such as sodium benzoate to extend the shelf life of their products. This illegal practice is also harmful to consumers. The shelf life of fishballs might be improved by reducing the initial and subsequent microbial counts through the use of simple refrigerators and improving sanitary working conditions.

In view of the high bacterial contamination and short shelf life of fishballs produced in Malaysia, a system of quality control must be implemented to improve product quality. Hazards and CCPs have been identified at various stages of fishball processing. Follow-up studies will focus on control measures,

target level and tolerance, monitoring procedures and corrective action.

Although many large factories have been set up to produce surimi-based products in recent years, there is still a niche for the small-scale processor of fresh fishballs to be sold on the day of production in wet markets. Consumers should be advised not to store fishballs for more than three days and should cook them thoroughly before consumption.

Acknowledgement

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References

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Disucssion

Ms Yu clarified that the salt content of fish balls was 2-3%. The representative from Thailand noted that the implementation of CCP could be prerequisite to HACCP in order not to shock the fishball processors. The representative from the ASEAN-Canada Fisheries Post-Harvest Technology Project - Phase II suggested that the criteria may be divided into safety and non-safety factors, so that when the actual HACCP is used, there is surely a factor of safety.

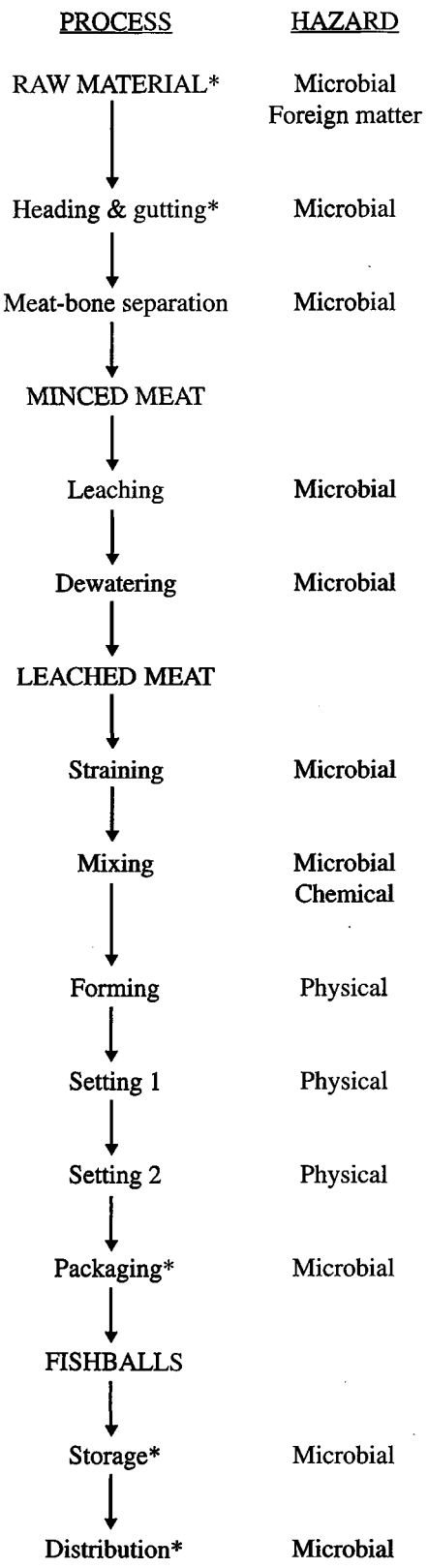

Fig. 1. Hazards and CCPs in fishball processing. *CCP